ECG

Contents

Overview

Digital telemetry ECG monitoring provides continuous monitoring of electrocardiographic signals in order to detect abnormal cardiac rhythms, including life-threatening arrhythmias such as asystole, ventricular fibrillation, and ventricular tachycardia.

Setting Up ECG Monitoring

To initiate ECG monitoring:

1 Select a transmitter.
2 Note its channel number.
3 Attach lead wires to transmitter.
4 Attach lead wires to electrodes.
5 Apply electrodes to patient.
6 Install a transmitter battery.
7 Close the transmitter case

To set up ECG monitoring, plug each lead wire into the transmitter, connect each to an electrode, and then attach the leads to the patient. Match the lead wire color to the color-coded connectors on the top of the transmitter case. Refer to the *ECG* chapter in the *UCN Operations Manual* for details regarding electrode application. Telemetry patients are commonly ambulatory and require optimal skin preparation and lead application to minimize motion artifact. After the electrodes and lead wires have been attached, it is important to tape a loop of lead wire close to the electrode to minimize stress or pulling on the electrode itself. This is called stress-looping.

ECG monitoring begins when the telemetry receiver module detects a signal sent by a telemetry transmitter. The telemetry transmitter sends a signal as soon as its battery is installed.

ECG telemetry reception requires the following minimum conditions:

- The telemetry receiver module must be connected to an Ultraview or PCMS monitor, either directly or through a module housing, with the power ON and a Spacelabs Medical diversity antenna connected.
- ECG electrodes must be properly attached to the patient; and lead wires must be properly attached to the transmitter.
- The transmitter battery must be functional.
- The telemetry receiver module must be tuned to the telemetry transmitter's frequency (channel number).

- *All system connections must be made by Spacelabs Medical personnel only.*
- *Leakage currents are not affected by the high level output. The patient is electrically isolated from the patient monitor by the RF link.*

WARNING:

- ***Operating television receivers or other CRT displays near the transmitter (within 2 to 3 feet), or operation of some pacemaker programmers may suppress the ECG waveform, preventing QRS detection and rate counting. An erroneous asystole alarm may result.***
- ***Signals resulting from devices such as Automatic Implantable Cardiac Defibrillators (AICD) may momentarily blank the ECG trace rather than display an out-of-range signal. In such cases, it may not be apparent that the AICD has signaled and the condition of the patient should be checked. In all instances of AICD signaling, the bedside or central will redisplay the ECG waveform within 5 seconds.***

ECG monitoring in telemetry is identical to hardwired ECG monitoring. Refer to the *ECG*, *Arrhythmia*, and *ST Analysis* chapters of the *UCN Operations Manual* for detailed descriptions of configurations, displays, and controls. A brief overview of ECG monitoring follows.

Electrodes

For ECG tracing with telemetry, use silver/silver-chloride electrodes or their equivalent. Always connect all the electrodes required for a particular lead. Missing electrodes may result in the loss of ECG tracing. Refer to the *ECG* chapter in the *UCN Operations Manual* for information on placing the electrodes.

WARNING:

- ***Use only Spacelabs Medical recommended electrodes. Some electrodes may be subject to large offset potentials due to polarization. Recovery time after application of defibrillator pulses may be especially compromised. Squeeze bulb electrodes, commonly used for diagnostic ECG recording, may be particularly vulnerable to this effect.***

CAUTION:

- **Visually inspect each lead wire for obvious damage and replace them as needed.**
- **Only use patient cables and lead wires specified by Spacelabs Medical. Other cables and lead wires may degrade performance and may damage the monitor during defibrillation. Non-Spacelabs Medical cables and lead wires may also change the required input impedance and DC offset voltage, affecting monitor performance.**
- **Do not use stainless steel electrodes.**
- **Do not allow conductive parts of electrodes and connectors, including the reference electrode, to contact other conductive parts, including the ground.**
- **Poor cable dressing or improper electrode preparation may cause line isolation monitor transients to resemble actual cardiac waveforms and inhibit heart rate alarms. Refer to the *ECG* chapter of the *UCN Operations Manual* for details on proper electrode preparation and application.**

Display Detail

Signal detection is indicated on your monitor when an ECG signal appears next to the ECG parameter key in the zone assigned to receive the transmitted telemetry channel. The transmitter's channel number is always identified above the waveform, to the left of the ECG key.

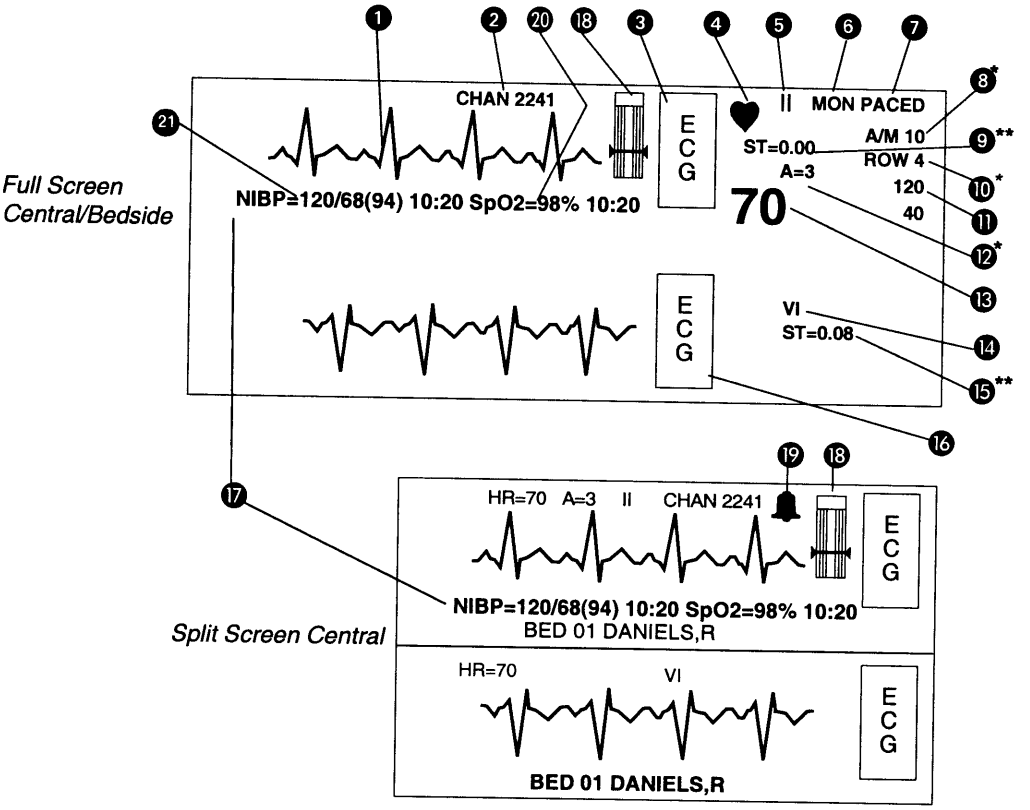

Figure 2-1: Display Detail

1. ECG trace for first lead
2. Telemetry channel number
3. ECG key for first lead
4. QRS indicator (flashes once per detected beat)
5. ECG lead designator
6. Display resolution (monitor or extended)
7. Paced operation indication (pacemaker detection is enabled)
8. Abnormals per minute alarm limit*
9. ST segment level for first lead **
10. Abnormals in a row alarm limit *
11. ECG rate alarm limits; split screen centrals display a bell symbol when alarms are enabled; bedsides display the rate alarm limits (120/40)

⓬ Abnormals per minute counter *

⓭ Current heart rate

⓮ ECG lead designator for second lead

⓯ ST segment level for second lead**

⓰ ECG key for second lead

⓱ NIBP measurements: systolic/diastolic (mean) at hours:minutes; SpO_2 measurement at hours:minutes (91343 only; hh:mm not seen on continuous SpO_2). Depending on the patient monitor's display size, the title "NIBP" may not appear.

⓲ SpO_2 SensorWatch bar: shaded area (waveform index) expands up proportionally to signal strength; horizontal line is minimum signal level. Waveform Index (WFI) is used for displaying signal strength in SensorWatch.

⓳ Large size bell indicates ECG alarms enabled.

⓴ Equal sign becomes a bell when SpO_2 alarms enabled.

Equal sign becomes a bell when NIBP alarms enabled.

* Only appears with the MultiView I or II option in the adult mode with Arrhythmia detection enabled.

** Only appears in adult mode with the ST segment analysis option.

Monitoring Paced ECG Patients

To monitor paced patients:

1 Touch ECG.
2 Touch SETUP.
3 Select PACED YES.

When monitoring pacemaker patients, use the paced feature to automatically enhance pacemaker spikes for display and eliminate them from the heart rate counter. The last YES/NO setting of the paced feature you select is retained as the default.

If the interval between the pacemaker pulse and the QRS complex is greater than 150 milliseconds, the beat is considered to have originated in the atria and is not classified as a paced beat.

To prevent pacemaker pulses from being counted as actual beats, specialized circuitry removes the pacemaker pulses from the ECG signal and replaces them with pacemaker flags.

- *The optimal leads for monitoring paced patients may vary. In telemetry monitoring, pacemaker spikes are detected on lead II. If pacemaker spikes are not detected, change the electrode position.*

WARNING:

- ***ECG detection circuitry may continue to count the pacemaker rate during occurrences of cardiac arrest or some arrhythmias. Do not rely entirely upon ECG rate alarms. Keep pacemaker patients under close surveillance.***
- ***The system may insert pacemaker flags into the ECG signal in response to signals that are not pacemaker pulses. Therefore, if you use a Spacelabs Medical monitor to observe pacemaker performance, you must take into account all possible sources of pacemaker flags.***
- ***Use the pacemaker manufacturer's performance analyzer as the primary means of evaluating pacemaker operation.***

Restoring Default Settings

To restore default settings:

1 Touch ECG.
2 Touch SETUP.
3 Touch RESTORE SETTINGS.
4 Select YES.

With the Module Configuration Manager feature, you can restore all default settings. User-configurable options are listed in the *Module Configuration Manager* chapter of the *UCN Operations Manual.*

- *RESTORE SETTINGS changes the user-configurable options for ALL parameters in the module.*
- *This feature is not available for remote views.*

Changing the Display Resolution

To change the display resolution:

1 Touch ECG.
2 Touch SETUP.
3 Select MONITOR or EXTENDED.

The MONITOR/EXTENDED key determines the display resolution of the two ECG traces, whether or not both traces are currently displayed on the monitor.

Table 1: Display Resolution

Key	Display Resolution
Monitor	(0.5 – 30 Hz)
Extended	(0.05 – 30 Hz)

- *Changing the display resolution does not change the waveform bandwidth used to analyze the ECG signals for the arrhythmia and ST segment level.*

The factory default setting for display resolution is monitor mode.

HI RATE ALARM

Displayed during high rate alarms for either 10 seconds or the duration of the alarm.

IN LEARN

Displayed when the software is in learn mode.

CHAN 1 & 2 LEADS OFF

Displayed when lead failures preclude ECG monitoring in both ECG channels 1 and 2. The message is displayed in the waveform zone for the first ECG channel. An alarm tone sounds if the module has completed its initial period of learning and ECG processing has not been suspended.

CHAN 1 LEADS OFF

Displayed when a lead failure occurs on ECG channel 1 when automatic lead switching is disabled.

CHAN 2 LEADS OFF

Displayed when a lead failure occurs on ECG channel 2. The message is displayed in the waveform zone for both ECG channels 1 and 2.

LO RATE ALARM

Displayed during low rate alarms for either 10 seconds or the duration of the alarm.

NEW DOMINANT

Displayed for 1 minute when a switch to a different dominant ECG morphology occurs.

NOISY SIGNAL

Displayed in ECG channel 1 when the ECG software suspends processing on either channel because of excessive noise on the ECG signal. After 10 seconds in this condition, an alarm tone sounds if ECG alarms are enabled and alarm tones have not been turned OFF or suspended. This message is displayed for the duration of the noisy signal condition plus approximately three seconds. The patient may be moving excessively. Secure the lead wires to the patient.

- Check the electrodes for good skin adhesion.
- Check lead wires at the transmitter for contact.

RUN ALARM

Displayed whenever a RUN of three or more beats is detected and the ABN IN ROW limit is set lower than or equal to the number of beats in the run. This message is displayed for either 10 seconds or the duration of the alarm.

V FIB

Displayed whenever ventricular fibrillation is detected. This message is displayed for either 10 seconds or the duration of the alarm.

SpO_2 (91343 only)

Contents

Overview

Pulse oximetry enables you to noninvasively monitor a patient's hemoglobin oxygen saturation either continuously or episodically. The oximetry sensor contains two light emitting diodes (LEDs) that transmit specific wavelengths (approximately 660 and 940 nanometers) of light that are received by a photodetector.

Oxygen saturated blood absorbs light differently than unsaturated blood. Thus, the amount of light absorbed by the blood can be used to calculate the ratio of oxygenated hemoglobin to total hemoglobin in arterial blood. This ratio is displayed as percent SpO_2. Normal values range from 95 to 100%.

WARNING:

- ***A pulse oximeter should NOT be used as an apnea monitor.***
- ***A pulse oximeter should be considered an early warning device. If a trend towards patient deoxygenation is indicated, blood samples should be analyzed by a laboratory co-oximeter.***

- *With the Module Configuration Manager feature, you can define your own default settings for characteristics such as alarm limits, alarm priority, and display configuration. Refer to the* Module Configuration Manager *chapter in the* UCN Operations Manual *for further details.*
- *Blood oxygen saturation monitoring must be performed in conjunction with ECG monitoring. The ECG lead wires of the 91343 must be connected to the patient in order to perform ECG and blood oxygen saturation monitoring.*

Setting Up SpO_2 Monitoring

To set up SpO_2 monitoring:

1 Open the battery cover and remove the battery.
2 Confirm that the DIP switches 1 through 8 are in the correct setting (switch 7 must be set to ON for neonatal use and to OFF for adult use).
3 Reinstall the battery and close the battery cover.
4 Connect the SpO_2 adapter cable (P/N 700-0014-00) to the transmitter.
5 Attach the sensor to the patient and connect the sensor cable to the SpO_2 adapter cable.
6 Initiate ECG monitoring.
7 Touch ECG.
8 Touch CHANNEL FORMAT.
9 Select SpO2 ON.

The 91343 digital telemetry multi-parameter transmitter uses Spacelabs Medical sensors as well as those from other manufacturers. Refer to *Accessories* on page 1-13 for information concerning specific sensors.

CAUTION:

- **Use only patient sensors specified by Spacelabs Medical. Using sensors other than those specified may degrade performance and damage the transmitter during defibrillation.**
- **Check the sensor site frequently. Do not allow the sensor to remain on one site for a prolonged time, especially when monitoring neonates. Refer to the sensor manufacturer's instructions.**
- **Never attach an SpO_2 sensor on a limb being monitored with a blood pressure cuff or a limb with restricted blood flow.**
- **A poorly applied sensor may give inaccurate saturation values.**
- **Choose a site with sufficient perfusion to ensure accurate oximetry values.**

All sensors require an adapter cable between the sensor and the transmitter. Because the adaptor cable is reusable, do not discard it when you have finished using a disposable oximetry sensor. Disconnect the sensor cable from the adapter cable before discarding the sensor.

To connect the SpO_2 adapter cable to the transmitter, align the cable with the notch on the front of the transmitter connector, and push the cable straight down into the transmitter. To remove the cable, press the latch release on the bottom of the cable, and pull the cable straight out.

CAUTION:

- **Never twist the cable.**

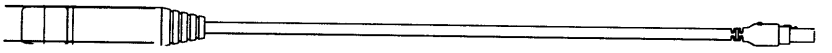

Figure 3-1: SpO_2 Adapter Cable to Transmitter

To enable SpO_2 monitoring in the 91343 digital telemetry multi-parameter transmitter, choose an averaging interval of 4, 8, or 16, seconds by setting DIP switches 1 and 2 as explained in *Setting SpO2 Data Averaging Period and Sampling Interval* on page 3-6.

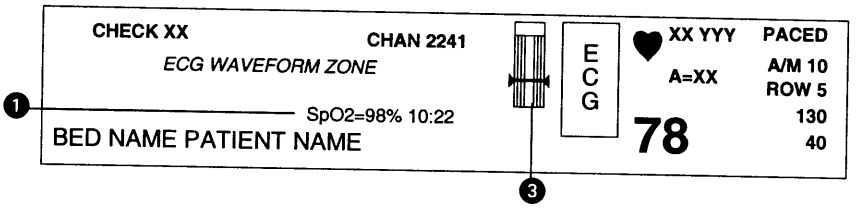

Figure 3-2: Display Zone — Full Screen

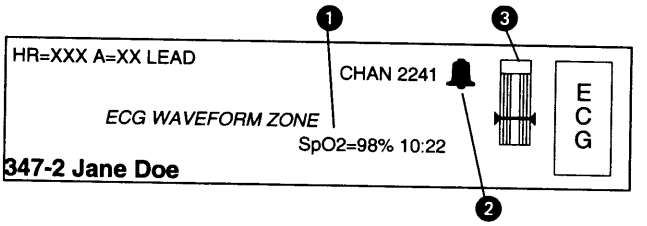

Figure 3-3: Display Zone — Split Screen

❶ Current SpO_2 value (percent) and episodic time of reading. (Time is not displayed when using continuous mode of operation.)

❷ The bell indicates that alarms are enabled (equal sign turns to a small bell when SpO_2 alarms are enabled).

❸ SensorWatch bar:

Shaded area (waveform index, WFI) expands up proportionally to signal strength; horizontal line is minimum signal level.

No shading (lowest waveform index) corresponds to no detected signal strength or a faulty sensor.

- *When the battery voltage in the 91343 falls below 5.5 volts, the SpO_2 value is displayed as **???** and the sensor watch bar is empty.*

Ensuring Accurate Monitoring

Each sensor requires site specific application procedures, and the following general points will aid oximetry monitoring success.

- Choose a site that provides proper alignment of the LEDs and receiving photodetector.
- Reduce light interference when monitoring under bright light by using a light block over the sensor.
- Select a site that has unrestricted blood flow and can remain as immobile as possible to reduce or eliminate movement artifact.
- Do not restrict blood flow when securing a sensor with tape.
- Do not select a site near potential electrical interference (e.g., electrical cords).
- The SensorWatch bar should be above the minimum signal level.

Setting or Adjusting Alarm Limits

To set or adjust SpO_2 alarms:

1 Touch ECG.
2 Touch ALARM LIMITS.
3 Touch SPO2 ALARM LIMITS.
4 Select SpO2 ALARMS ON.
5 Select HI=, LO=, ALM DELAY, and MSG ALARM DELAY.
6 Use arrow keys to adjust.

Pulse oximetry alarm limits and delays are based either on factory default limits or user-defined limits. The factory default settings for alarm limits are 100% for high and 85% for low. For alarm delays, the factory default settings are 15 seconds for alarm limit delay and 20 seconds for message alarm delay. Refer to the *Alarms* chapter in the *UCN Operations Manual* for details concerning UCN alarm operation.

When SpO_2 alarms are enabled, a bell symbol will be displayed between the "SpO_2" label and the SpO_2 measured saturation value. When any SpO_2 alarm is detected, the displayed parameter value (item 1 in *Figure 3-2* and *Figure 3-3* on page 3-3) will blink yellow if the alarm priority is Low or Medium, and will blink red if the alarm priority is High. This is done independently of any other ECG or NIBP alarm indications.

When SpO_2 alarms are enabled and the SpO_2 high limit is exceeded, the SpO_2 High=XXX key will blink in the color of the highest priority alarm present. When the SpO_2 low limit is exceeded, the SpO_2 Low=XXX key will blink in the color of the highest priority alarm present. Refer to *Directory of Keys - UCW and Ultraview 1700* on page 1-1.

Refer to the *Module Configuration Manager* chapter of the *UCN Operations Manual* for SpO_2 parameter tables that list available user settings and factory defaults for this parameter.

- *The following ECG alarm messages take priority over other ECG and SpO_2 alarm messages for display. Other ECG and SpO_2 alarm messages can be adjusted in priority by using the Module Configuration Manager.*

  LEADS OFF

  NOISY SIGNAL

  ECG ALARMS SUSPENDED

ALM DELAY Key

This key sets the number of seconds the system will wait before it reports that an alarm limit has been violated. When this feature is OFF, the key label will read "ALM DELAY OFF". When it is on, the label will read "ALM DELAY xx", where "xx" is the value, in seconds, of the delay.

To set the delay time:

1. Touch ALM DELAY xx (or ALM DELAY OFF).
2. Touch the up and down arrow keys until the value is set as desired. Possible settings are OFF, 5, 10, 15, 20, 25, or 30 seconds.

- *If you press the down arrow key after the lowest value has been reached, the following message will appear on the prompt line:*

  Minimum alarm delay time has been reached.

- *If you press the up arrow key after the highest value has been reached, the following message will appear on the prompt line:*

  Maximum alarm delay time has been reached.

MSG ALM DELAY Key

This key sets the number of seconds the system will wait before it issues an alarm tone after any of the following messages:

- SpO_2 UNAVAILABLE
- SpO_2 FAULTY SENSOR
- SpO_2 SENSOR DISCONNECTED
- SpO_2 SENSOR OFF PATIENT
- SpO_2 INSUFFICIENT SIGNAL
- SpO_2 AMBIENT LIGHT INTF.
- SpO_2 NOISY SIGNAL

When this feature is OFF, the key label will read "MSG ALM DELAY OFF". When it is ON, the label will read "MSG ALM DELAY xx" where "xx" is the value, in seconds, of the delay.

To set the message delay time:

1. Touch MSG ALM DELAY xx (or MSG ALM DELAY OFF).
2. Touch the up and down arrow keys until the value is set as desired. Possible settings are OFF, 10, 20, 30, 40, 50, or 60 seconds.

- *If you press the down arrow key after the lowest value has been reached, the following message will appear on the prompt line:*

  Minimum message alarm delay time has been reached.

- *If you press the up arrow key after the highest value has been reached, the following message will appear on the prompt line:*

  Maximum message alarm delay time has been reached.

Setting SpO_2 Data Averaging Period and Sampling Interval

To set SpO_2 data averaging period and sampling interval, set transmitter DIP switches 1 through 4 to correct configuration

SpO_2 data averaging is used to smooth the oximetry saturation value by averaging the patient input values over 4, 8, or 16 seconds. This selection is made by setting the DIP switches 1 and 2 beneath the battery compartment in the 91343 digital telemetry multi-parameter transmitter. The default value is 8 seconds. Refer to *Figure 3-4* on page 3-6.

- *Setting both DIP switches 1 and 2 to ON disables SpO_2 data transmission.*
- *To enable SpO_2, remove the battery, set the selected interval, and re-install the battery.*
- *Disabling SpO_2 operation in the 91343 transmitter lengthens battery life.*

CAUTION:

- **Use care when configuring the DIP switches. Avoid using pens or pencils to configure the DIP switches since they may cause contamination. Avoid using sharp cutting instruments which may cause physical damage.**

Table 1: DIP Switch 1 and 2 Settings

DIP Switch 1	DIP Switch 2	Effect
OFF	OFF	4 seconds averaging enabled
OFF	ON	8 seconds averaging enabled (default)
ON	OFF	16 seconds averaging enabled
ON	ON	Disable SpO_2 operation

The current setting of the SpO_2 averaging period may be displayed by pressing the ECG CHANNEL FORMAT key and enabling SpO_2.

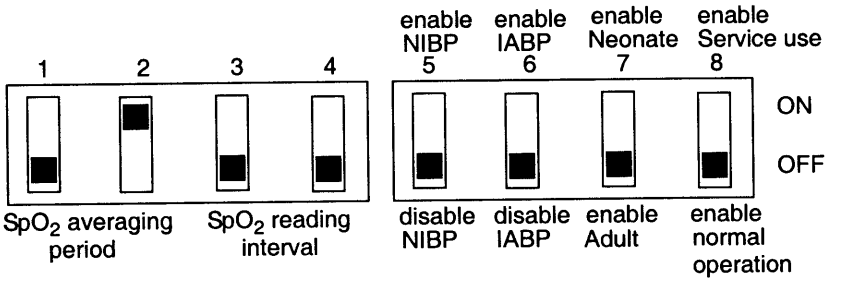

Figure 3-4: DIP Switch Setting in Battery Compartment

The sampling interval selection enables you to determine how often an SpO_2 measurement will be taken. Less frequent SpO_2 readings can extend the usable life of the battery. (Refer to the Ultraview Digital Telemetry Products data sheet, P/N 061-0801-xx, for more information on battery service life.) This selection is made by setting DIP switches 3 and 4 beneath the battery compartment. The default setting is in continuous.

CAUTION:
- **No SpO_2 monitoring occurs between episodic sampling intervals. Clinical practice or medical judgement should be used in selecting continuous or episodic SpO_2 monitoring mode for each specific patient.**

Table 2: DIP Switch 3 and 4 Settings

DIP Switch 3	DIP Switch 4	Effect
OFF	OFF	Continuous sampling (default)
OFF	ON	2 minute sampling interval
ON	OFF	5 minute sampling interval
ON	ON	30 minute sampling interval

CAUTION:
- **DIP switch 8 must remain OFF for normal operation.**

Viewing Pulse Rate

To display heart rate from SpO_2 sensor:

1 Touch ECG.
2 Touch SETUP.
3 Touch RATE SOURCE.
4 Select SpO2 ON.
5 Select SpO2 as rate source.

In normal operations, the heart rate for display is obtained directly from the acquired ECG leads or an alternate rate source. SpO_2 can be used as the alternate source, if it is set for continuous measurement. When it is set for episodic measurement, SpO_2 cannot be used as an alternate rate source.

SpO_2 with Intra-Aortic Balloon Pumps

To use with balloon pump:

1 Set transmitter DIP switch 6 to ON.

To view the current setting of the IABP DIP switch:

1 Touch ECG.
2 Touch CHANNEL FORMAT.
3 Select SpO_2 ON.

Enabling the intra-aortic balloon pump (IABP) feature informs the SpO_2 software that an IABP is in use. The 91343 must differentiate between true arterial pulsations and those produced by the IABP. With the IABP feature enabled, the transmitter excludes the IABP-generated pulsations from the calculation for SpO_2.

The IABP feature also may be useful with patients experiencing irregular heart rhythms. Enabling the IABP feature permits the transmitter to reject irregular pulses, providing a more accurate SpO_2 measurement.

- *When the IABP feature is enabled, the pulse rate obtained from SpO_2 may not match the heart rate obtained from ECG.*
- *In cases of excessive patient motion or artifact, the accuracy of the SpO_2 measurement may be compromised when the IABP feature is enabled.*
- *When the IABP operation is selected, the SpO_2 status key in the Channel Format menu indicates IABP.*

Using SpO_2 with Neonates

Enabling neonatal operation, by setting transmitter DIP switch 7, changes the sensor detection operation in the transmitter, improving the signal quality for neonatal patients. This switch must be set ON for neonatal use and set OFF for adult use. When the neonate operation is selected the SpO_2 status key in the Channel Format menu indicates NEO.

SpO_2 Alarm Message Summary

WARNING:

- ***Error messages indicate a problem or condition that may affect accurate monitoring values. Do not ignore these messages. Correct any fault before continuing.***

- *When any SpO_2 alarm message is displayed, the saturation value is immediately changed to ??? and an alarm is triggered. If your module has been configured for an alarm using the Module Configuration Manager the parameter display will blink yellow for Low and Medium priority alarms, and will blink red for High priority alarms. An alarm will begin after the message alarm delay time has elapsed. (Refer to the* Module Configuration Manager *chapter of the* UCN Operations Manual*).*

SpO_2 SENSOR DISCONNECTED

Displayed when the transmitter does not detect either an adapter cable or a sensor connected to an adapter cable. If the message persists and the adapter cable is secure, replace the adapter cable. The alarm will stop after approximately 10 seconds. On remote view, there may be no audible alarm on the remote mainframe before the local alarm stops.

SpO_2 FAULTY SENSOR

The 91343 SpO_2 processor has detected a defective sensor that will require replacement. The SensorWatch bar can be used to confirm absence of sensor output.

SpO_2 UNAVAILABLE

Displayed when the LED and/or photodiode have failed. Replace the sensor and/or SpO_2 adapter cable.

SpO_2 AMBIENT LIGHT INTF.

Displayed when:

- The sensor is receiving external light interference from a bright light source near the sensor. Shield the sensor from the external light source. If the condition persists for more than 30 seconds, **???** will replace the data display.
- The sensor photodiode and LEDs are misaligned on flexible sensors allowing light to enter. Realign the sensor photodiode with LEDs.
- If a message appears with finger clip, replace the sensor.

SpO_2 INSUFFICIENT SIGNAL

Displayed when:

- Insufficient signal for proper operation.
- Poor sensor application or site. Correctly re-apply or reposition to a more perfused site, massage the site, or apply a new sensor.

SpO_2 NOISY SIGNAL

Displayed when:

- The sensor signal is disturbed by motion or other interference. Eliminate sensor movement. The message disappears when a value is obtained.
- The sensor is placed adjacent to power cords or other electrically noisy devices. Move the noisy device or move the sensor to another site.

SpO_2 SENSOR OFF PATIENT

Displayed when:

- The transmitter is unable to detect a valid sensor input signal. Check the patient for proper sensor placement.This alarm is only available when the SpO_2 sensor is a reusable, finger-clip type.

- *This message is not available with disposable SpO_2 sensors or non-clip type sensors.*

- Tissue between the LED and photodiode is too transmissive. If sensor placement seems correct and the message persists, try a sensor site with a thicker tissue bed.

- *Adapter cables and sensors are ordered separately through the Spacelabs Medical Supplies Products Catalog.*

SpO_2 Troubleshooting Guide

Clinical Situation	Possible Cause	Solution
No SpO_2 label is displayed	■ SpO_2 is not enabled at the 91343.	■ Be sure transmitter DIP switch 1 and 2 are set correctly.
	■ SpO_2 is not enabled at the 90478 receiver.	■ Be sure transmitter DIP switch 8 is OFF.
SpO_2 value displays ???	■ Sensor not connected to patient.	■ Re-attach sensor.
	■ Adapter cable not connected to module properly.	■ Correctly connect the adapter cable.
	■ Sensor not connected to adapter cable.	■ Correctly connect the sensor.
	■ Excessive patient motion.	■ Urge patient to remain still while reading is in progress.
	■ Transmitter is in the initialization phase (the first 15 seconds after sensor application).	■ Wait until initialization is complete.
	■ Low battery indicator constantly illuminated.	■ Call qualified service person.
Insufficient signal or noisy signal	■ Sensor placement not optimum.	■ Move sensor to a site with better perfusion.
		■ Align LED with sensor photodetector.
	■ Sensor placed below blood pressure cuff.	■ Move sensor to an alternate limb.
Intermittent or complete failure to operate	■ Depleted battery.	■ Replace battery.
	■ Low battery light constantly illuminated.	■ Call qualified service person.
Factors that cause significant variances in sensor accuracy	■ Presence of dysfunctional hemoglobins (COHb, MetHb).	■ Follow hospital procedure for determining oxygenation in these patients.
	■ Presence of intravascular dyes (indocyamine green, methylene blue) depending on their concentration in the blood stream.	■ Follow hospital procedure for determining oxygenation in these patients.
	■ High ambient light level.	■ Reduce light levels near patient; wrap sensor with light blocking material.
	■ Electrosurgical interference.	■ Ultraview digital telemetry is contra-indicated for electrosurgical use.
	■ Patient is significantly anemic (Hb less than 5 gm/dl) or patient has received large amounts of IV solutions.	■ Follow hospital procedure for determining oxygenation in these patients.

SpO_2 Troubleshooting Guide (continued)

Clinical Situation	Possible Cause	Solution
No SpO_2 alarms are displayed	■ ECG "Leads Off" condition exists. ■ Higher priority alarm condition is present.	■ Re-attach ECG lead wires to patient and resume ECG monitoring to clear pending ECG alarms. ■ Clear current alarm condition and/or reprioritize SpO_2 alarms of interest in the Module Configuration Manager. ■ When SpO_2 alarms are set ON, all SpO_2 alarm conditions will cause the parameter value (or ???) to blink according to the alarm priority set by using the Module Configuration Manager.